LOWER CLARK FORK RIVER MONITORING PLAN

1984 - 1985

REVISED MARCH 1984

REVISED APRIL 1984

MONTANA DEPARTMENT OF HEALTH AND ENVIRONMENTAL SCIENCES

WATER QUALITY BUREAU

ROOM A206 COGSWELL BUILDING

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INTRODUCTION

A large amount of public concern has been expressed in recent months over the general health of the lower Clark Fork River system. The proposed modification of the existing wastewater discharge permit for the Champion International paper mill at Frenchtown has generated much of this concern. Other sources of wastewater, namely the City of Missoula wastewater treatment plant (WWTP) and historic metals deposits originating upstream from Milltown Dam, have also been mentioned as possible sources of stress on the river.

The preliminary environmental review (PER) of the proposed permit modification for Champion International (Water Quality Bureau, January 1984) outlined a water quality and biological monitoring program that would establish existing conditions and attempt to measure any changes that may result from the proposed permit modification. Comments received on the PER included several suggested changes and additions to the monitoring program. This document incorporates many of those suggestions and describes more completely the monitoring program that the Water Quality Bureau initiated in March 1984.

This document does not describe: 1) the self and compliance monitoring that will be involved in administering the Champion and City of Missoula wastewater discharge permits; 2) annual macroinvertebrate surveys funded by Champion International and conducted by the Institute of Paper Chemistry; or 3) any studies or monitoring conducted by personnel from the Montana University System, the State of Idaho, or other state and federal agencies in Montana, such as the U.S. Geological Survey and the Department of Fish, Wildlife and Parks (DFWP).

This last agency has expressed a desire to study fish populations in the lower Clark Fork River in order to determine: 1) major spawning and rearing areas; 2) migration patterns, including tributary use; 3) food habits and growth rates; and 4) age structure. In addition, the Water Quality Bureau will try to find someone who is capable of conducting *in situ* bioassays on trout eggs or fry at selected locations along the river. These fish bioassays and population studies would be conducted concurrently with the monitoring described herein.

The Water Quality Bureau welcomes comments on this monitoring plan. Groups and individuals are invited to rendezvous with Bureau field personnel and observe monitoring procedures. The Bureau is also seeking volunteers to record water quality conditions along the river. Interested persons may call 444-2406.

This monitoring will be funded jointly by the State of Montana Department of Health and Environmental Sciences (DHES), the U.S. Environmental Protection Agency, and Champion International. Field work will be accomplished by personnel from the Water Quality Bureau. Laboratory chemical analyses will be performed by the Chemistry Laboratory Bureau of the DHES. Biological laboratory work will be done by Water Quality Bureau staff or contracted to private consultants. A final report on this and related monitoring in the Clark Fork River will be prepared by the Water Quality Bureau, with input from DFWP and Champion International.

OBJECTIVES

1. To establish a chemical, physical, and biological water quality baseline for the lower Clark Fork River in Montana.

2. To measure any changes in water quality that may result if and when Champion International is allowed to discharge year-round.

3. To determine the contributions, environmental effects, and downstream fate of water quality contaminants from various wastewater sources and tributaries along the river.

GENERAL DESCRIPTION

This monitoring plan encompasses about 225 miles of the lower Clark Fork River from Turah (upstream from Milltown Dam) downstream to the Idaho border, including the Blackfoot, Bitterroot and Flathead Rivers (Figure 1). In addition to 31 fixed water quality stations on the river, its four mainstream reservoirs and three major tributaries, the Bureau will collect samples from up to six deepwater pools between Frenchtown and Thompson Falls Reservoir. Sampling will be conducted several times per year for a minimum of two years beginning in 1984. A variety of chemical, physical and biological water quality variables will be measured in several hundred samples collected from both shallow waters and from the bottoms of deepwater pools and reservoirs. In addition to the scheduled sampling, field personnel will look for and record any incidental evidence of water quality degradation.

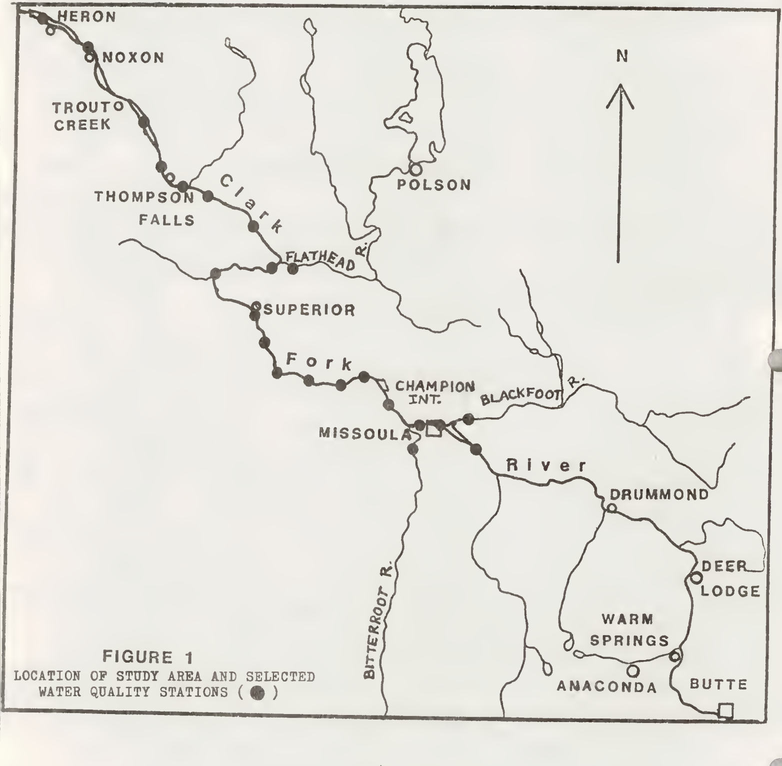

FIGURE 1
LOCATION OF STUDY AREA AND SELECTED WATER QUALITY STATIONS (●)

METHODS

Unless otherwise specified, samples will be collected, preserved and analyzed using standard procedures contained in one of the following references:

American Public Health Association, American Water Works Association, and the Water Pollution Control Federation. 1981. Standard Methods for the Examination of Water and Wastewater. 15th Edition, 1980. American Public Health Association, Washington, D.C.

U.S. Environmental Protection Agency. 1982. Handbook for Sampling and Sample Preservation of Water and Wastewater. EPA-600/4-82-029.

U.S. Environmental Protection Agency. 1983. (Revised). Methods for Chemical Analysis of Water and Wastes. EPA-600/4-79-020.

Weber, C.I. (ed.). 1983. Biological Field and Laboratory Methods for Measuring the Quality of Surface Water and Effluents. EPA-670/4-73-001.

Specific procedures are referenced below as appropriate.

MONITORING APPROACH

The types of samples that will be collected and some of the water quality variables that will be measured are listed in Table 1. Table 2 identifies the water quality stations at which each type of sample will be collected. The following narrative explains the reasons for collecting each type of sample and for measuring some of the more significant water quality variables.

Surface Grabs (Low Flow)

These samples will attempt to quantify the contributions of water quality contaminants from various waste sources and the major tributaries. With the high-flow samples below, they will help establish nutrient and suspended solids budgets for the river and assess the instream consequences of cumulative contaminant loading. Existing streamflow gaging stations will be used to measure or estimate river and tributary discharge. With estimates of river travel time between stations, an attempt will be made to follow downstream and to sample at each station the same "slug" of water. This is called synoptic water quality monitoring. Low-flow samples for all variables will be collected in March, August, and November at 31 stations.

Surface Grabs (High Flow)

Additional samples for total suspended solids, volatile suspended solids and algal nutrients will be collected at 16 stations several times each year during snowmelt runoff and periodically during base flow. Besides helping to establish loads and budgets, these high-flow samples will help to estimate the amount of deposition of organic and inorganic solids in the mainstem

Table 1. SAMPLE TYPES AND WATER QUALITY VARIABLES

SURFACE GRABS (LOW FLOW)

Field dissolved oxygen
Field temperature
Field pH
Biochemical oxygen demand
Chemical oxygen demand
Color (natural pH and pH adjusted)
Metals (total recoverable As, Cu, Cd, Zn, and Fe plus SCAN)
Total suspended solids
Volatile suspended solids } depth-integrated sample
Nutrients (nitrate, nitrite, ammonia and kjeldahl nitrogen, ortho-phosphorus and total phosphorus
Lab pH
Specific conductance
Hardness

SURFACE GRABS (HIGH FLOW)

Total suspended solids
Volatile suspended solids } depth-integrated sample
Nutrients (same as low flow grab)

BOTTOM AND SURFACE GRABS

Field dissolved oxygen
Field pH
Field temperature
Metals (arsenic, copper, zinc, lead, cadmium, iron, manganese, chromium and silver - dissolved and total recoverable)
Hardness
Lab pH
Specific conductance

BOTTOM SEDIMENT (3 replicate samples per station)

Field hydrogen sulfide (qualitative)
Percent organic content
Metals (same as list above - total and total recoverable)

DEEPWATER BIOLOGY (3 replicate samples per station)

Benthic macroinvertebrates (Ponar grab)

SHALLOW-WATER BIOLOGY (natural substrates)

Macroinvertebrate traveling kicknet samples
Composite periphyton collections
Periphyton chlorophyll/biomass grab samples

SHALLOW-WATER BIOLOGY (artificial substrates)

Periphyton chlorophyll/biomass accrual
(3 replicates per station - summer only)

OPEN-WATER BIOLOGY

Phytoplankton composition and density
Phytoplankton chlorophyll
Secchi Disc transparency

SURFACE DIURNAL DISSOLVED OXYGEN (summer only)

Dissolved oxygen
Field temperature
(every 3 hours for 24 hours)

FOAMING TENDENCY AND STABILITY

Surface grab sample

Table 2. WATER QUALITY STATIONS

Stations	Discharge*	Surface Grabs (low flow)	Surface Grabs (high flow)	Bottom and Surface Grabs Bottom Sediment and Deepwater Biology	Shallow-water Biology (Natural Substrates)	Shallow-water Biology (Artificial Substrates)	Open-water Biology	Surface Diurnal Dissolved Oxygen	Foaming Tendency and Stability
CFR at Turah	E	X	X		X	X		X	
Blackfoot R. nr. mouth	M	X	X		X				
Milltown Reservoir		X		X			X		
CFR blw. Milltown Dam	M	X	X		X				
CFR abv. Missoula	M	X			X				
CFR abv. Missoula WWTP	E	X	X		X	X		X	X
Missoula WWTP Effluent	M	X	X						X
CFR blw. Missoula WWTP	E	X			X	X		X	
CFR at Sheffields	E	X	X		X	X			X
Bitterroot R. nr. mouth	E	X	X		X				X
CFR at Harper Bridge	M	X	X		X	X		X	X
Champion Outfall (or pond water)	M	X	X						X
CFR .5 mi blw. Outfall	E	X		up to 6 deep pools	X	X			
CFR 5 mi blw. Outfall	E	X			X				
CFR at Huson	E	X	X		X	X		X	X
CFR at Ninemile	E	X							
CFR at Alberton	E	X							
CFR at Tarkio	E	X						X	
CFR at Lozeau	E	X			X			X	
CFR at Superior	E	X						X	X
CFR blw. St. Regis River	M	X	X		X			X	
CFR abv. Flathead River	E	X						X	
Flathead R. nr. mouth	M	X	X		X			X	X
CFR at Plains	M	X			X			X	
CFR abv. Thompson Falls Res.	E	X	X		X		X		X
CFR in Thompson Falls Res.		X		X			X		
CFR blw. Thompson Falls Dam	E	X	X		X				X
CFR in Noxon Reservoir		X		X			X		
CFR blw. Noxon Dam	M	X	X		X				X
CFR in Cab. Gorge Res.		X		X			X		
CFR blw. Cab. Gorge Dam	M	X	X		X				
Total Stations.		31	16	10	20	7	5	12	12

* E = Estimated
M = Measured

reservoirs when retention time is shortest and when Champion International is discharging directly to the river.

Bottom and Surface Grabs

Identical water samples will be collected at the same time from the surface and near the bottom of the four mainstem impoundments (Milltown, Thompson Falls, Noxon and Cabinet Gorge) and from up to six deepwater pools between Frenchtown and Thompson Falls. This type of sampling is designed to determine whether dissolved oxygen and pH are depressed near the bottom of deepwater areas, and whether such depressions result in a mobilization (solution) of heavy metals that may be contained in the bottom sediments. (See "Bottom Sediment" below.) Water will be brought up from the bottom using a pump or a Kemmerer or Van Dorn water bottle lowered from a boat. The key variables here are dissolved oxygen, pH and selected heavy metals. The importance of dissolved (and biologically effective) metals in this context will require filtering one set of metals samples in the field.

Bottom Sediment

In light of the quantities of heavy metals that have been reported in the sediments behind Milltown Dam, it is reasonable to assume that there are elevated levels of heavy metals in the sediments of downstream pools and reservoirs. Samples of sediment will be collected with a Petite Ponar Grab (bottom dredge) from the same ten pools and reservoirs sampled for bottom and surface grabs. (See above.) The sediment will be analyzed for concentrations of heavy metals, percent organic content, and the presence or absence of hydrogen sulfide. Comparing the organic content of sediments

from behind Milltown Dam to those of still, deep waters downstream may indicate whether there is appreciable deposition and accumulation of organic solids originating from the Missoula WWTP, Champion International, terrestrial or instream sources (algae production).

Cantillo, A.Y., S.A. Sinex and G.R. Helz, 1984. Elemental Analysis of Estuarine Sediments by Lithium Metaborate Fusion and Direct Current Plasma Emission Spectrometry. Analytical Chemistry, Vol. 56, No. 1, pp. 33-37

Deepwater Biology

From the same ten reservoirs and pools, replicate samples of benthic macroinvertebrates will be brought up with a Petite Ponar Grab. These benthic biology samples will be used to assess environmental conditions in the bottom sediments, including the biological effects of any heavy metals and organic deposits and the presence or absence of dissolved oxygen.

Shallow-Water Biology

Riffles are the most productive habitats in rivers for benthic algae and macroinvertebrates (fish food). The kinds and diversity of organisms living in these habitats tell a great deal about the nature and degree of stress placed upon a river by various water quality contaminants. Analysis of chlorophyll and biomass in grab samples of slime (microbial growth) from natural substrates on the river bottom will indicate the relative importance of producers (algae) and consumers (bacteria, fungi, etc.) in the benthic community, and in turn the significance and cumulative effects of organic loading to the river. Measurements of algae production on artificial

substrates (glass slides) will indicate the biostimulation effects of nutrients discharged by the Missoula WWTP and Champion International.

Lowe, R. L. 1974. Environmental Requirements and Pollution Tolerance of Freshwater Diatoms. EPA-670/4-74-005.

Lange-Bertalot, H. 1979. Pollution Tolerance of Diatoms as a Criterion for Water Quality Estimation. Nova Hedwigia, Beiheft 64, pp. 285-304.

Open-Water Biology

The concentration of chlorophyll in the phytoplankton (suspended algae) communities of the four mainstem reservoirs will be measured during spring, summer, and fall. Chlorophyll concentrations will be converted to algal biomass and compared to ambient nutrient concentrations in order to assess eutrophication potential in Clark Fork River reservoirs according to criteria published by the U.S. Environmental Protection Agency. Secchi disc transparency will be measured on each visit.

Strickland, J.D.H. and T.R. Parsons. 1972. A Practical Handbook of Seawater Analysis. Bulletin 167 (2nd Edition), Fisheries Research Board of Canada, Ottawa.

Mills, W.B., J.D. Dean, D.B. Porcella, S.A. Gherini, R.J.M. Hudson, W.E. Frick, G.L. Rupp, and G.L. Bowie. 1982. Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants. EPA-600/6-82-004a.

Surface Diurnal Dissolved Oxygen

Dissolved oxygen and water temperature will be measured every 3 hours over a 24-hour period at low flow in midsummer. The 12 stations will bracket the Missoula WWTP and Champion International, with 8 stations clustered below the

latter facility in order to pinpoint the reach of river subject to the maximum depression in dissolved oxygen. The data collected from this intensive effort will help to model and predict dissolved oxygen concentrations at different stations under varying conditions and to determine the probability of violation of the State's dissolved oxygen standard at different levels of organic loading.

Foaming Tendency and Stability

A procedure is available for measuring foaming tendency and foam stability in terms of equivalent concentrations of alkyl benzene sulfonate (detergent). Although it was developed for pulp and paper mill effluents, it can and will be used on natural waters and other types of effluents, including the effluent from the Missoula WWTP. This test will assess the relative importance of wastewater effluents and natural agents as foam producers in the Clark Fork River system.

Carpenter, W.L. and I. Gellman, 1967. Measurement, Control, and Changes in Foaming Characteristics of Pulping Wastes During Biological Treatment. Tappi, Vol. 50, No. 5, pp. 83A-86A.

Water Quality Reconnaissance

During the course of the monitoring program described above, field personnel will look for and record any incidental evidence of water quality degradation and environmental stress. They will make a written and photographic record of their observations and look particularly for the following: foam, sludge deposits, slime growth, stained rocks, colored or cloudy water, foul-smelling water, wastewater discharges, dead or sickly fish. Sludge deposits and slime growth will be collected and analyzed

microscopically for constituent micro-organisms. Sickly or recently dead fish will be collected and frozen for autopsy and tissue analysis. Apparatus will be carried along to collect biological organisms, to measure temperature, pH and dissolved oxygen, and to detect hydrogen sulfide. An extra supply of sample containers and preservatives will be included for sampling biological communities, contaminated water, dicharges and other potential sources of pollution.

PRELIMINARY BUDGET

1984

Salaries	$30,000
Benefits (18%)	5,400
Overhead (13%)	4,602
Per Diem (225 days at $38.50)	8,662
Travel (10,000 vehicle miles at $0.25)	2,500
Boat and motor rental, fuel	1,000
Sampling supplies	500
Laboratory supplies (biological)	250
Chemical analyses (DHES Chemistry Lab.)	59,261
Biological Analyses (contracted services)	8,820
	$120,995

1985

Salaries	35,000
Benefits (18%)	6,300
Overhead (13%)	5,369
Per Diem (225 days at $38.50)	8,662
Travel (10,000 vehicle miles at $0.25)	2,500
Boat and motor rental, fuel	1,000
Sampling supplies	500
Laboratory supplies (biological)	250
Chemical analyses (DHES Chemistry Lab.)	59,261
Biological analyses (contracted services)	8,820
Typing, printing, and postage	750
	$128,412

Total	$249,407